IAF EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Data Systems and Technology (4)

Author: Dr. Jordan Kildare
University of South Australia, Australia

Mr. Jarrad Knight
University of South Australia, Australia
Dr. Michael Evans
University of South Australia, Australia
Dr. Yee Wei Law
University of South Australia, Australia

SYNTHESIS OF A MULTISPECTRAL IMAGE DATASET FOR ML-BASED SPACE SURVEILLANCE

Abstract

Space surveillance involves detecting and tracking high-speed vehicles, such as re-entry vehicles. Due to the excessive speeds of atmospheric re-entry, objects entering the atmosphere from space are heated significantly, and emit strongly in mid-wavelength infrared (MWIR) regime. However, MWIR satellite imagery is significantly limited in the public domain, thus limiting capability for training machine learning (ML) algorithms to detect atmospheric entry in this band. Despite the limited MWIR imagery, there is a wealth of data from the Landsat program that encompasses both short-wavelength infrared (SWIR) and long-wavelength infrared (LWIR) bands. The availability of this data provides some scope for interpolation between these measurements to generate the missing bands. This work proposes a diffusion model that incorporates existing spectral data to generate MWIR band data from the surrounding spectral measurements. A hyperspectral data source — Earth Observation 1's Hyperion instrument — is used to develop the training dataset, where the input bands are selected to match the bands available from the Landsat instruments. A two-stage process is used to improve the quality of the predicted spectra. First, from the initial set of inputs, additional bands are predicted to extend the range of measurements. Second, the expanded dataset is used with a different diffusion model to predict the missing band. The model is compared with an alternative model where both EO-1 Hyperion and Landsat data are used during the training process, rather than just EO-1 Hyperion. It is projected that both models will be capable of reproducing known spectra and will show realistic spectra when extended outside of the training range. However, validation in the extrapolated region is challenging. Analysis of the distributions of the weights within the diffusion models through clustering algorithms and data fusion will be used to identify physically meaningful patterns to support the validity of this method.